



Energy and Moisture Control in Hawai'i Buildings

Building Science Applications

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Key Ideas

- Dry not cold
- Manage the outdoor interface
- The devil is in the details

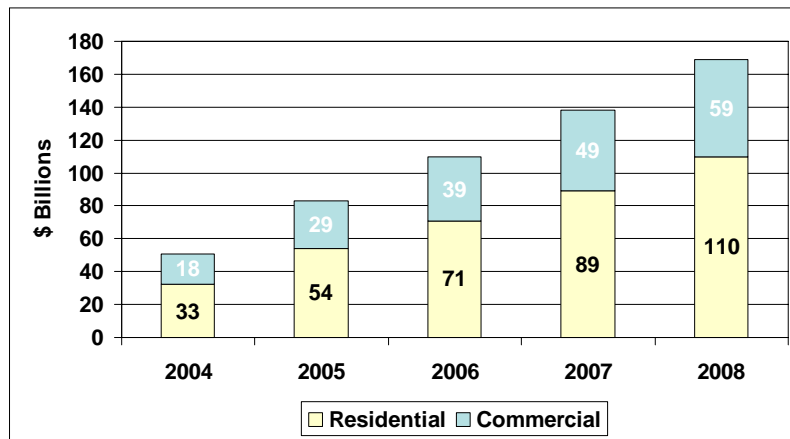
Case Study: Hilton Hawaiian Village

- Kalia Tower, with more than 400 rooms, completed in 2001
- \$95 million building
- History of moisture control failure
 - ✦ Mold found early 2002
 - ✦ Tower closed June 2002
 - ✦ Tower reopened September 2003
- More than \$55 million in cost to Hilton



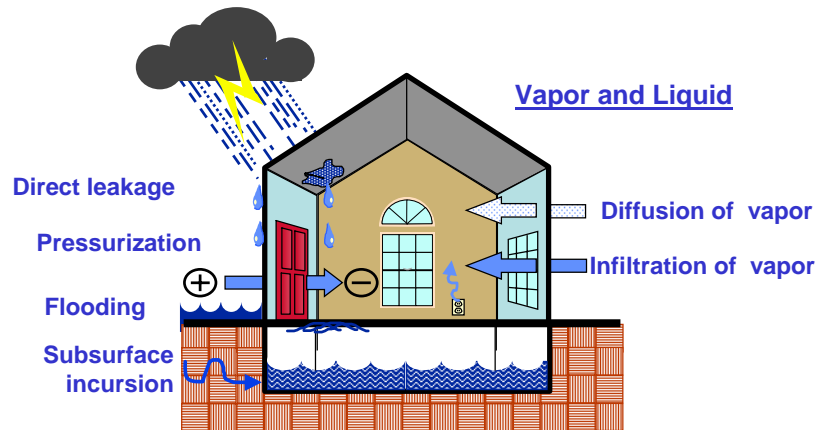
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US Real Estate Assets at Risk for Moisture Related Failures

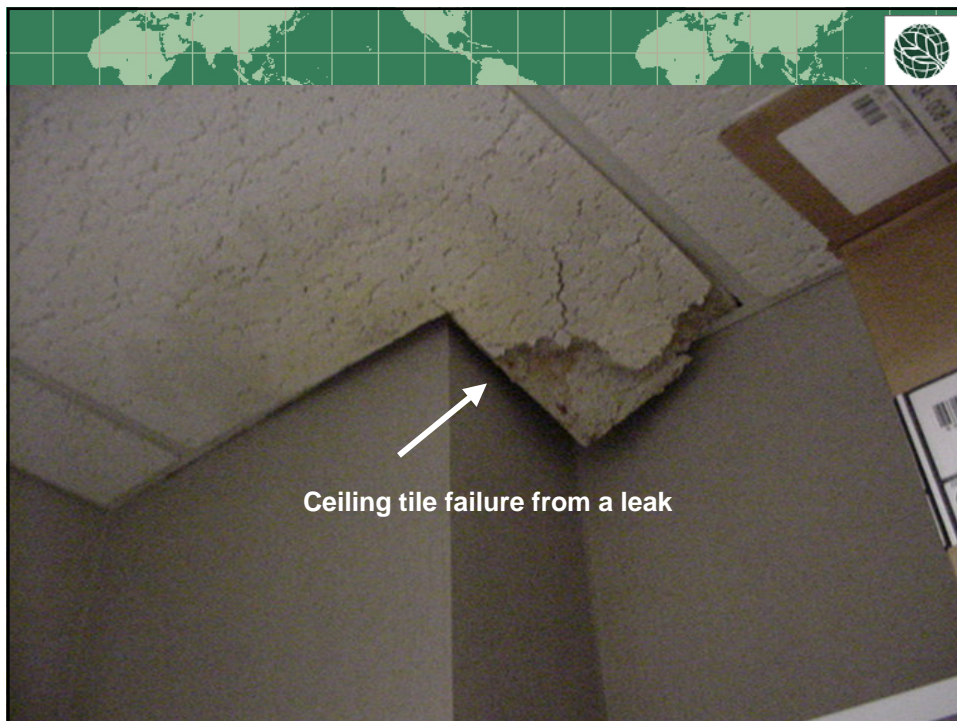


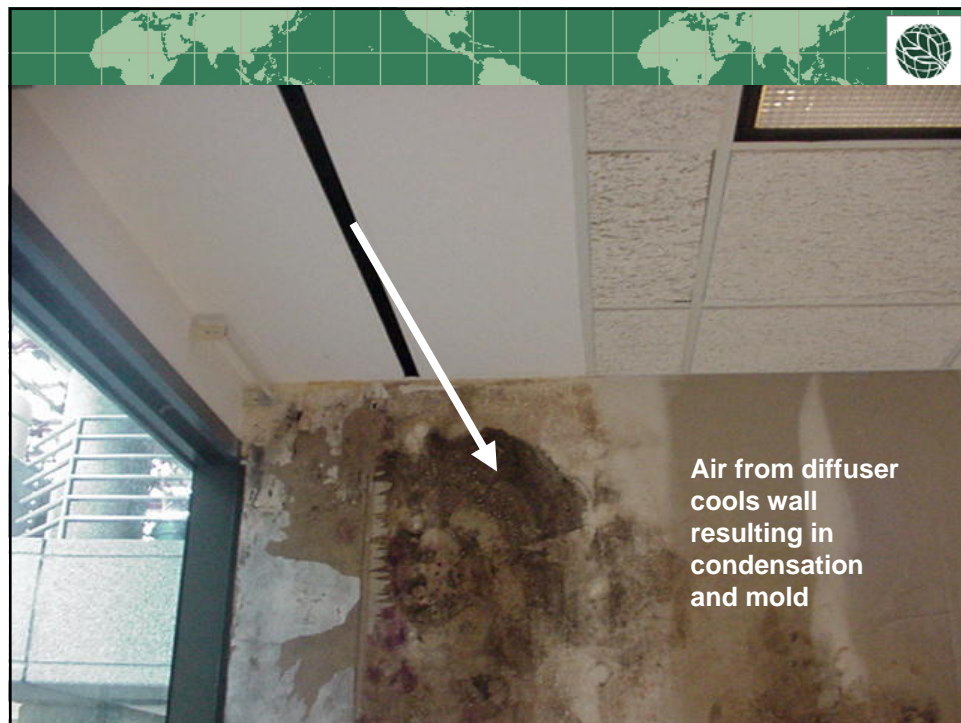
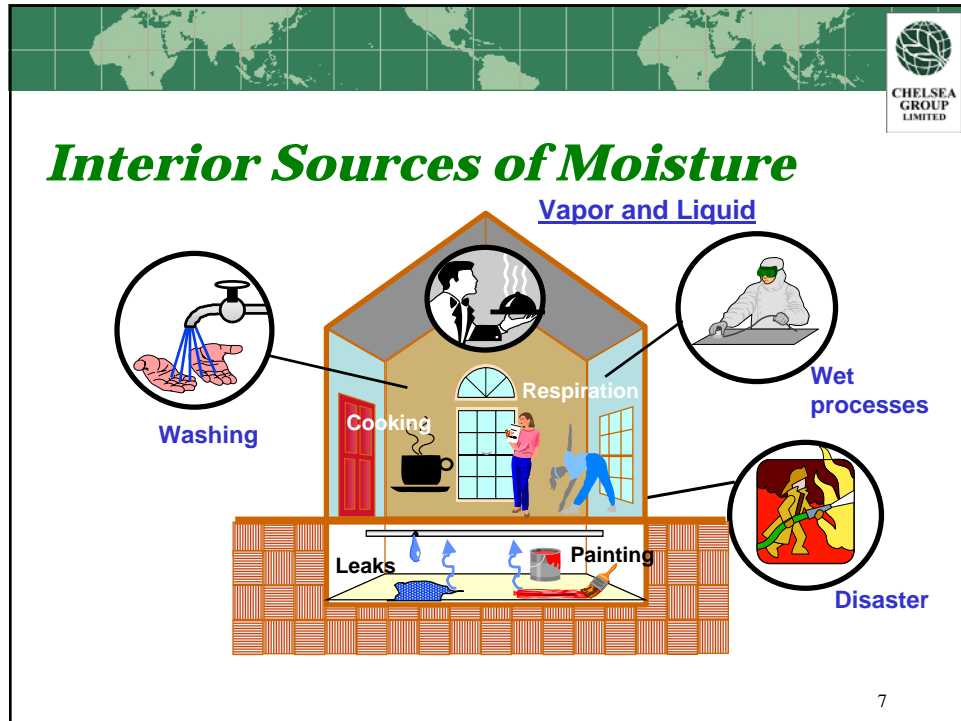
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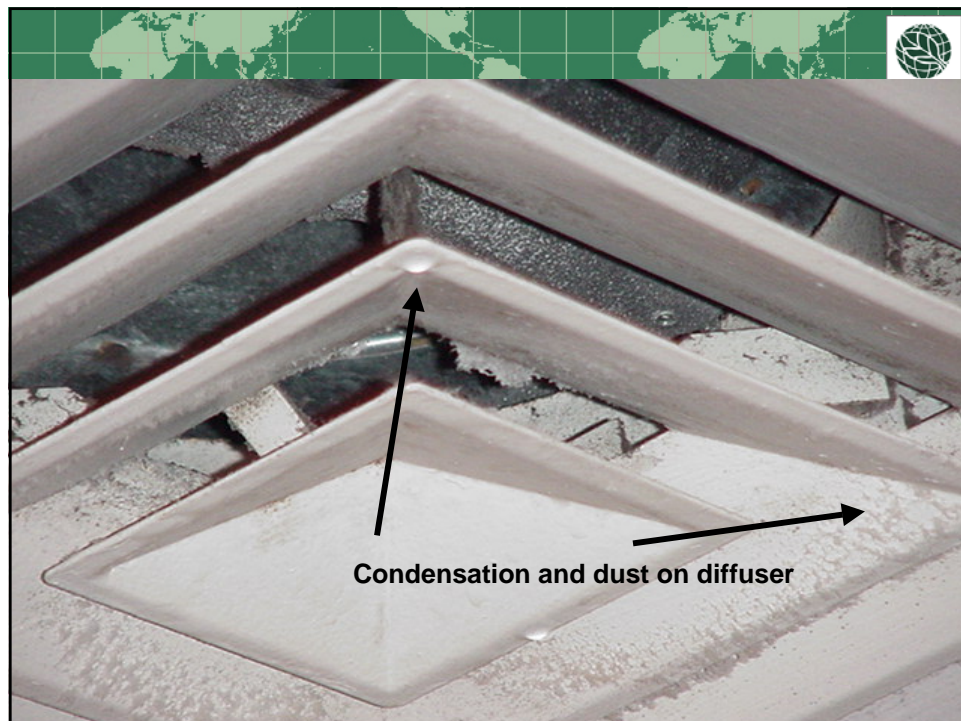
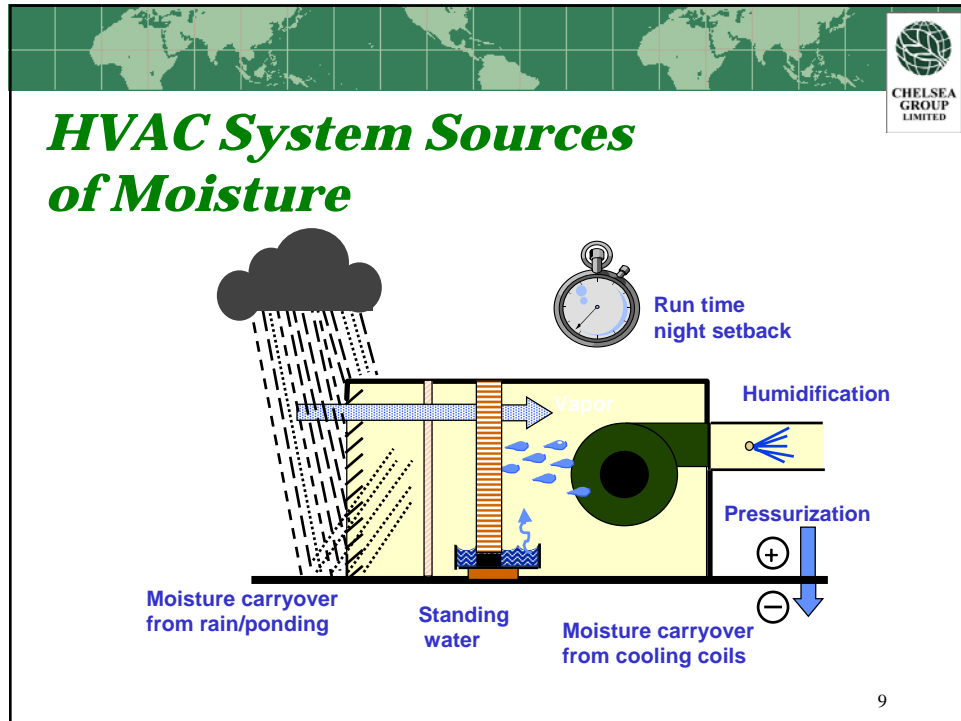
Exterior Sources of Moisture



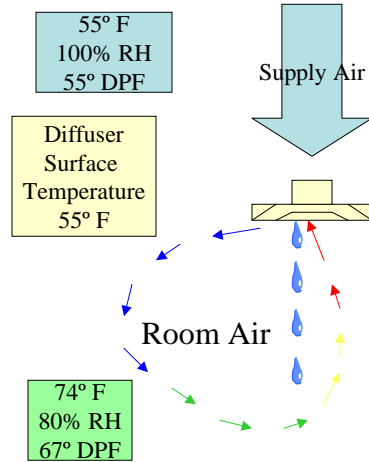
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Who'll stop the rain?



Problem:

- ♦ As long as diffuser surface temperature is below room dew point, it will rain
- ♦ Dirt and mold accumulate on the diffuser

Solutions:

- ♦ Reheat supply air to room dew point
- ♦ Reduce room air dew point to below supply air temperature

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Architectural Hotspots

Leaks, drainage, wind-driven water intrusion

- ♦ Design and construction of flashings and penetrations is a critical factor in both moisture and energy management
- ♦ Maintaining the building envelope saves energy as well as preventing dampness and mold

Condensation points

- ♦ Outdoor-indoor interface in an "open" design
- ♦ Insulation and vapor barriers in mechanically cooled buildings

Materials selection

- ♦ Why modern buildings have more moisture problems

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Mechanical Issues

- Dehumidify
 - ✦ Deliver air with a dew point temperature of less than 55° F
- Ventilate
 - ✦ Deliver at least ASHRAE Standard 62-2001 amounts of outdoor air, clean and dry
- Pressurize
 - ✦ Keep a slight positive pressure on the building envelope

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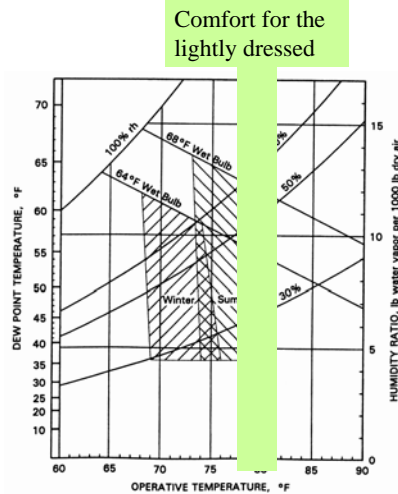
East to say... hard to do...

- How can I ventilate, pressurize *and* meet dew point temperature of less than 55° F and not bust the energy budget?
- How can I control the outdoor interface and meet occupant expectations?
- How can I attend to any more details in building operations?

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Solution Set #1

- Deliver dry air rather than cold air
 - ✦ Reheat or desiccant dehumidification in central systems
 - ✦ Apply to mixed natural and mechanical
 - ✦ Shoot for 78° - 82° F, 30 – 60% RH, or 50° - 55° F dew point



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Active Dehumidification

- Control to dew point rather than relative humidity
- Separate latent load (humidity) from sensible load (temperature) for control
- Use desiccants for energy efficiency
- Can be integrated or stand alone

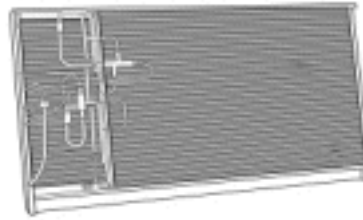


Modular Dehumidification Unit

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Package Rooftop Dehumidifier Option

- Uses refrigerant cycle to subcool and reheat
- Control on interior space humidity or dew point
- Sustains energy efficiency



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Solution Set #2

- Manage the outdoor interface to minimize dew point conditions
 - ✦ Deliver dry, ambient temperature air to interface areas
 - ✦ Choose stone and non-porous surfaces at interface
 - ✦ Avoid vapor barrier creation on adjacent interior surfaces

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Surface Dew Point Control

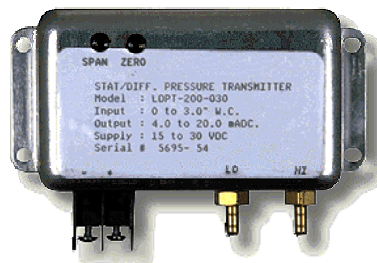


- Measure the dew point at critical surface points
- Manage temperature and humidity to keep ambient temperature $> 10^{\circ}\text{F}$ above surface dew point

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Pressure Management

- Reduce moisture intrusion
- Control cross-zone contamination
- More flexible space use



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Instant Winners – Energy Losers?

- Keep coil face velocity below 550 fpm
- Keep chilled water coil at 10° F below dew point
- Do not set up CHW temperature
- Do not duty cycle
- Operate systems 24/7

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Take Away Ideas...

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- Manage the outdoor interface
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